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MEMORANDUM TO : The Files DATE: 6 November 1956

25X1

FROM : [redacted]

SUBJECT: Report on the Second Annual Symposium on Aeronautical Communications October 8 to 10, 1956 at Utica and Rome, New York.

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This symposium was sponsored by the Rome-Utica Chapter of the Professional Grou[p] on Communications Systems of IRE and the theme was the present and future means of communications for military and civil aeronautical activities. The Symposium was broken up into five sessions as follows:

Session I - Communication System Concept.
Session II - Equipments and System Components.
Session III - Communication System Consideration.
Session IV - Communication Techniques.
Session V - Classified Sessions.

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SESSION I - COMMUNICATION SYSTEM CONCEPTS

"USAF Aeronautical Communications: A Link in the Servo Control Loop" - by Lt. Gen. Joseph Smith, Hqs, MATS.
Due to General Smith's absence, this paper was presented by Colonel Dungan who represented MATS.

Since World War II, the needs for aeronautical communications from a central control point direct to aerial vehicles, wherever they may be in the global air ocean, has become increasingly apparent to the Air Force system planners. Colonel Dungan discussed the inadequacy of ground-air communications for turbo-jet aircraft as it presently exists. The shortcomings of present day air traffic control were discussed and it was conclusively stated that:

(1) There is no oceanic traffic control in the North Atlantic area.

(2) There is no air-to-ground continuity.

(3) There is no acceptable air navigational system.

The biggest and most urgent program was considered to be the North Atlantic magnetic area where communication links are a complete blank during disturbances.

In conclusion, Col. Dungan pointed out that the requirements for MATS is a decent Servo Control Link.

"A Method for Studying Data Transmission Requirements for Large Systems" - by Dr. Joseph E. Barmack, Dunlap & Associates, Inc.

This paper described the method utilized in 1952-1954 for the study of the Air Force data transmission requirements for ground-to-air, air-to-ground, and air-to-air transmissions for the years 1958 through 1960. In the study, it was found that not enough emphasis was being given to human engineering analysis when human operated hardware was involved. The design engineer and operational personnel were interviewed for the purpose of making equipment more compatible.

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25 YEAR RE-REVIEW

"A New Look at Communications in the Field Army" -
by Major Henry P. Hutchinson, US Army Reserve.

This paper was developed during the author's Training Duty assignment in March, 1956. The paper outlined the characteristics applicable to voice, written message, and visual modes of communications as given below:

Parameters	Voice	Written	Visual
Time to prepare	None	Time to compose	None for TV Time to prepare for FAX
User-to-User Time Domain	Real	Delayed time	Real for TV 3 to 5 mins., for FAX
Type of exchange	two-way or Multiple	one-way	one-way, two-way for TV Multiple for FAX
Time to Comprehend	Time to receive and understand	Decrypting time and time to read, understand	Immediately or 5 minutes
Transmission Security	None	Function of Crypto	Function of Crypto
Ability to take action <u>before</u> enemy can take counter action.	Functional Mission time.	Joint function of mission time and crypto	Joint function of mission time and crypto
Maximum Transmission Rate	100-200 wpm	Depends on system	As assigned

The paper placed major emphasis on the determination of system requirements from the viewpoint of the user's needs rather than the technique used. For example, for tactical use visual mode is considered superior for the combat officer usage.

"The Four Systems Tests" -
by Major Walter White, Jr., Office of the Chief Signal Officer, Department of the Army.

Modern warfare and new concepts for the army of the future have placed increased emphasis and new demands on the signal and communications system of an army in the field. This paper discussed the following four system tests of the Signal Corps which are being evaluated by the Army Electronic Proving Ground, Fort Huachuca, Arizona:

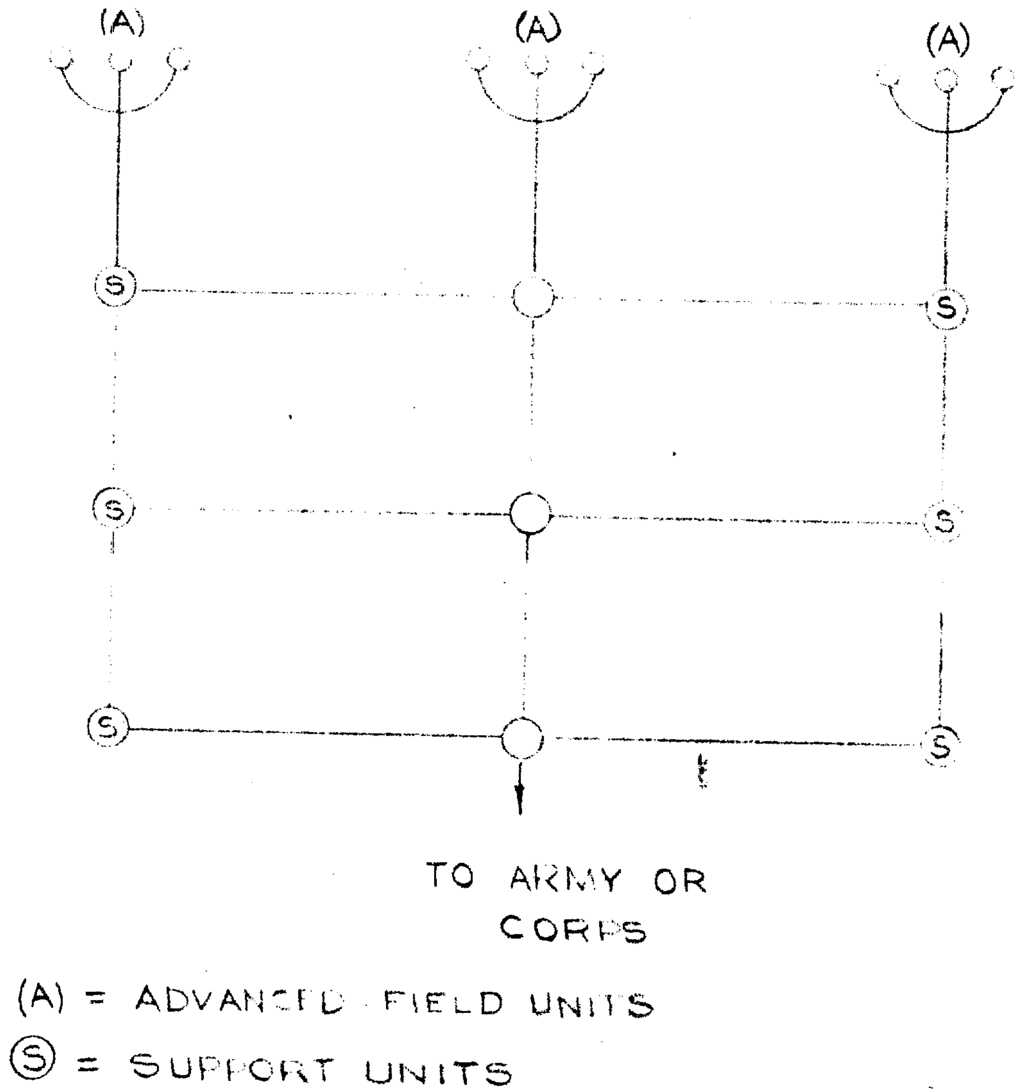
(1) Grid Communications System

(2) Army-Air Traffic Control and Navigational System

(3) Battle Area Surveillance System

(4) Electronic Warfare System

The Grid Communications System on a Divisional level is one of the new ideas where greater mobility and control of communications can be maintained. The following diagram shows such a system:



The Army-Air Traffic Control and Navigational System is primarily being evaluated with the cooperation of the Air Force.

The Battle Area Surveillance System is the responsibility of G-2 which gathers information via Infra-Red, Television, Radar, Photographic, Optical and Acoustic Seismic modes. The Michigan University has a contract from the Army for the purpose of outlining a usable Battle Area Surveillance System of data reduction and analysis for all echelons.

The Electronic Warfare System is responsible for intercept and jamming activities. This system is being thoroughly evaluated for its highest degree of effectiveness in support of field commands.

SESSION II - EQUIPMENTS AND SYSTEM COMPONENTS

"A One Kilowatt High Level Modulated UHF Amplifier with Low Distortion" - by Mr. G. R. Weatherup, RADC

For certain military applications, a need has existed for a UHF amplifier which will increase the output of presently available transmitters, such as the 100 watt, 225-400 mcs, Model T-217A/GR. The operational requirements placed upon this equipment were as follows:

(a) To maintain solid line of sight transmissions

(b) To maintain communications in the presence of high noise and jamming.

(c) To maintain communications during adverse weather conditions.

In addition there has been a requirement to provide this desired amplifier with a high level modulation system having broad band audio response and low harmonic and intermodulation distortion.

The design of a suitable system to fulfill the above requirements was completed and tested at Griffiss Air Force Base. It consists of four racks as follows:

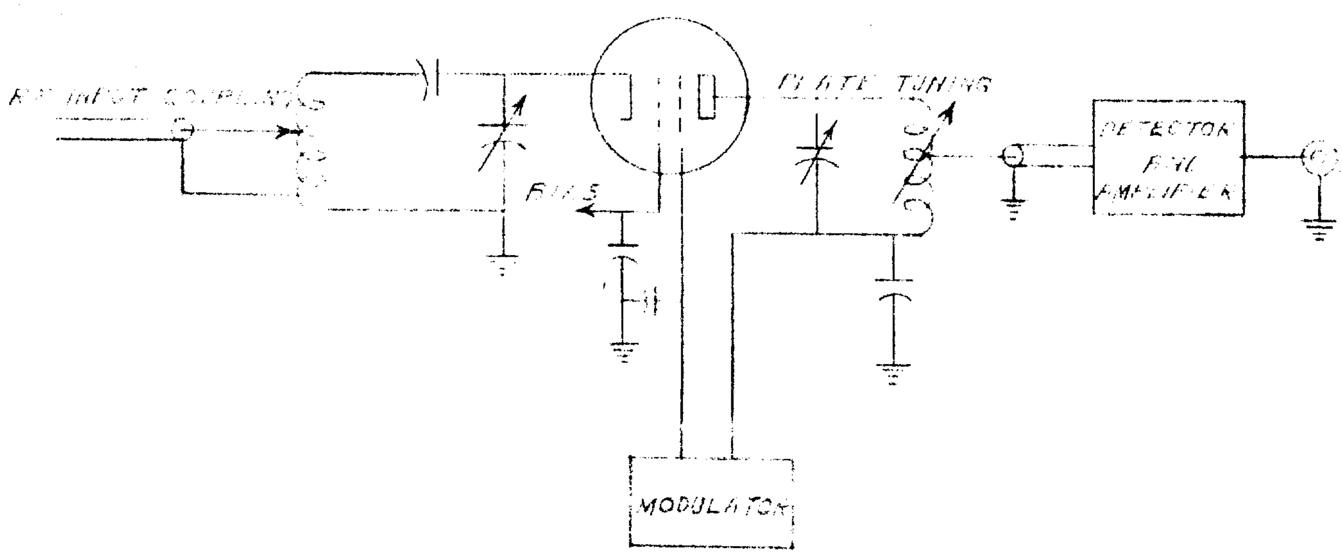
Rack I - Radio Transmitter T-217A/GR
Control AN/GRA-24
Modulator power supply, MD-129A

Rack II - Radio Modulator

Rack III- RF Amplifier

Rack IV - Power Control

The RF Amplifier uses a 6L6182 and schematically appears below:



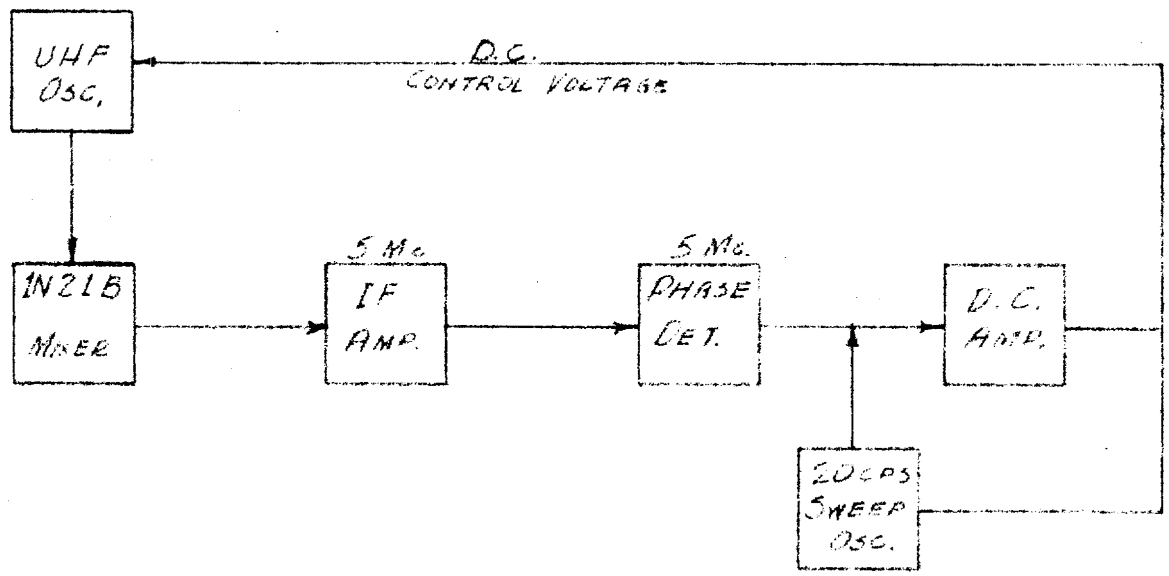
The modulator employs two 4-1000A and one 4E27A tubes.

Tests indicate that there is less than 3% rms distortion.

The entire system may be operated with complete success by semi-skilled personnel.

"A UHF Exciter for AM, FM, or SSB" -
by Henry A. Musk, Westinghouse Electric Corp.

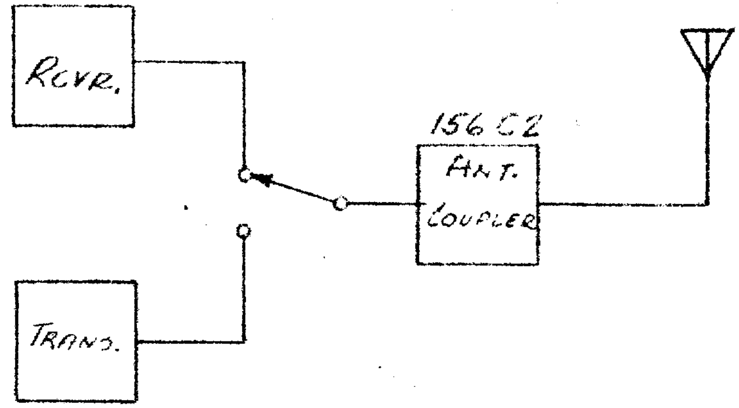
A novel UHF exciter, using a Colpitts oscillator and constructed in a can-type with physical dimensions of 5" high by 5" wide, has been developed to generate AM, FM, and SSB missions at 195 to 365 megacycles was described. A block diagram of the exciter is given below:



"A VHF-UHF Antenna Multicoupler Employing Resonant Cavities in Tandem" -
by M. W. Caquelin, Collins Radio Co.

Physical construction of a VHF-UHF antenna multicoupler employing resonant cavities in tandem was discussed. Model 156C2 having a frequency range from 225 to 400 megacycles and using 2 tunable cylindrical cavities approximately 1/4 wavelength at 220 mcs was described. The 2 cavities are 6 inches in diameter and connected in series. The physical dimensions of this unit are 21 inches deep, 7 inches high and 19 inches wide. The overall weight is 25 pounds. This model was designed to accommodate power requirements up to 200 watts, however, it has been reported by some users that one-kilowatt transmitters were used with success.

Below is a block diagram showing the arrangements for a Receiver and Transmitter using one antenna:



The Model 156B4 is so designed for four outputs (Receiver/Transmitter) using one antenna. The physical dimensions of this unit are 24 inches deep, 17 inches high and 19 inches wide.

Both models have a matching impedance of 50 to 50 ohms.

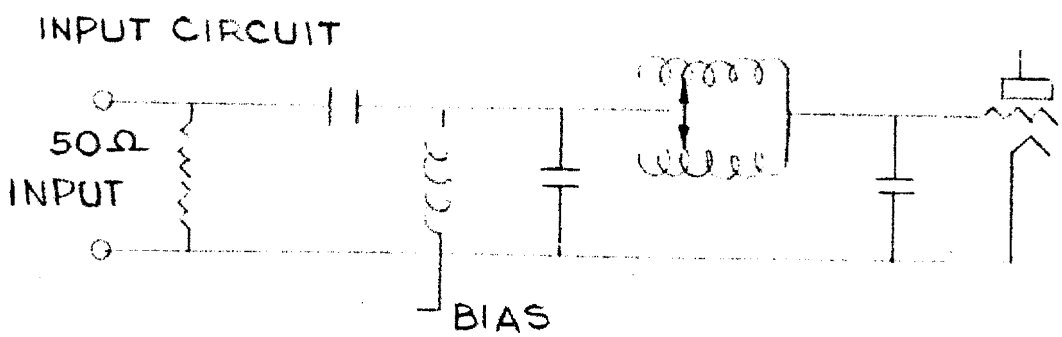
One of the advantages of this multicoupler is that it will solve many interaction problems that now exist within this spectrum.

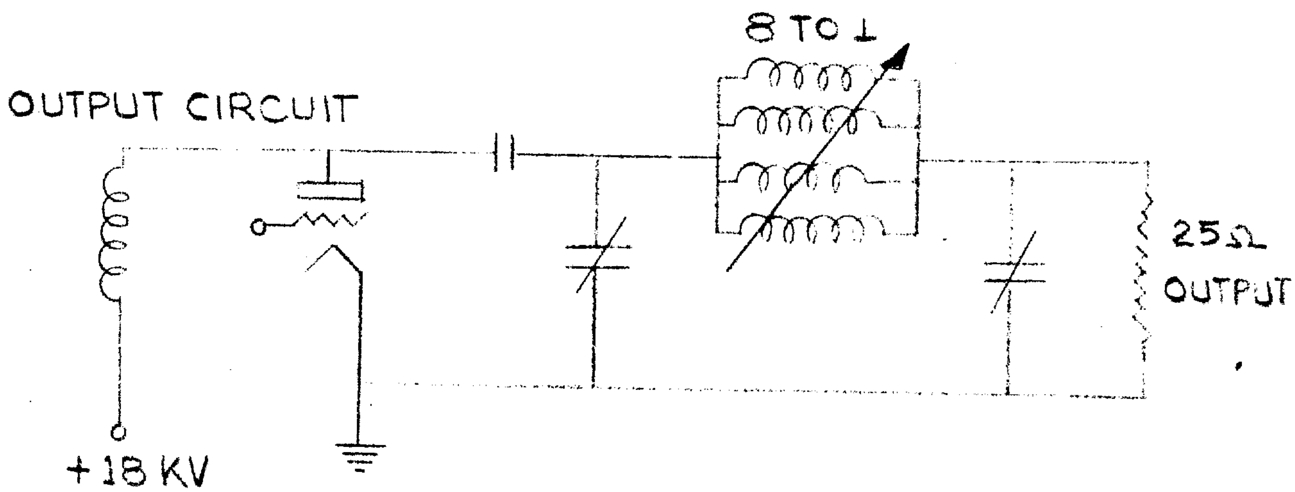
"A 600 Kilowatt High Frequency Amplifier" -
by James O. Weldon, Continental Electronics

A description was given of the electrical circuits and mechanical construction of a power amplifier designed primarily for use in single sideband suppressed carrier operation having a peak envelope power output of 600 KW. This amplifier was designed under a development contract for the Signal Corps., Fort.Monmouth.

The frequency range is 4 to 30 mcs. All variable tuning capacitors and inductance are controlled by motors. The physical dimensions of this amplifier are 54 inches deep, 72 inches wide and 78 inches high. The tube used in this amplifier is an RCA Type 2322C which weighs 150 pounds and is readily removed by a specially constructed block and tackle.

The schematic diagram for this amplifier is broken up into the input and output circuits:





SESSION III - COMMUNICATION SYSTEM CONSIDERATIONS

"AF Communications Problems and the Future Air Force Operational System" - by C. K. Chappuis, Rome Air Development Center

Air Force communications has expanded from the most elementary requirements in World War I to an enormous military world-wide industry. It exceeds the requirements and capabilities of commercial systems without standardization, engineering, installation and maintenance capabilities required for the job. The intent of this paper was to trace the history of communications for support of Air Force to the present; and project the problems and limited solutions into the future.

Subjects covered in this paper were as follows:

(a) World War I

(b) World War II

(c) Present Air Force Communications Situations which were further sub-titled:

(1) Strategic Air Command

(2) Air Defense Command

(3) Tactical Air Command

(4) Administrative, Logistics, Intelligence Traffic, etc.

(d) Long Range Missiles

(e) Commercial Traffic vs Air Force Traffic

The World-Wide problems of the Air Force Communications is one which cannot be solved in individual areas. The solution can only be found on a world-wide system basis inasmuch as the requirements are on this basis. An examination was made of the present systems and their functions so that they could be related to the world-wide system problem. Next a discussion was held on communications equipment available to the Air Force. It was not the intent here to list the equipments available but to discuss classes of equipments and general capabilities and limitations by classes of equipments.

Deficiencies of Air Force Communication Equipments and Sub-systems were briefly discussed under sub-titles of:

(a) High Frequency channels

(b) Radio Relay and Tropospheric Scatter Equipment

(c) Wire Cable Coaxial Cable

(d) Telephone Facilities

(e) Teletype Facilities

(f) Graphics Equipment

(h) General Discussion of Equipment Deficiencies.

Finally a brief outline of a concept for a new Air Force Communications System was given. The expansion of the concept will be subject for a second paper. The primary concept of such a system must involve the following:

Generally, this system must provide for a large number of high quality 4 kc channels, capable of reliable high speed automatic switching on a world-wide basis. Also, terminal equipments must be so designed as to eliminate special message center personnel and delays encountered in such operation. Completely militarized equipments standardized for Air Force application on a world-wide basis.

Compatibility with commercial communication systems so that the services can be integrated in peace or war as required. Numbers of equipments minimized and applications broadened. Universal use of nominal 4 kc channels since a multiplicity of these are available.

Flexibility to provide special services as required on an engineered basis. Constructed in modules for engineering and installation of facility expansion without changes. Unitized for maintenance purposes so that personnel of very low skill levels can protect and maintain the equipments. The units should be sealed, Go-No-Go, "Throwaway" types. By "Throwaway", it is meant that no attempt is made for local repair but that the units are immediately returned to supply for repair at large depots or at the factory. Simplified universal test equipments must be available for all types of plant facilities to enable operational personnel to quickly determine the transmission capabilities of all circuits.

(NOTE: Due to the many subjects and references covered by this paper, further detailed information may be requested for separate reporting.)

"An Integrated High Frequency Single Sideband System" -
by Mark I. Jacob, Westinghouse Electric Co.

Several years ago Westinghouse recognized the trend of utilizing SSB as a solution to specific problems facing civilian and military operations planners, undertook an extensive long range development program. It was the objective of this program to develop and produce designs for a complete line of equipment suitable for application in the high frequency (2.0 - 30 mc) spectrum and utilizing single sideband suppressed carrier emission. The units developed as a result of this program form the basic building blocks of an integrated communication system including a stable frequency generator, single sideband generator, linear power amplifier, and a receiver.

In this design simplification is achieved by utilizing circuit principles that result in few electron tubes. For example, the exciter unit developed for this system contains only 43 tubes. This exciter includes all circuitry necessary to derive a SSB signal from a 5 mc standard frequency source and deliver it at a 100 mw level in 1 kc intervals throughout the 2-30 mc hf range.

A brief Unit description of this system is given below:

Stable Frequency Generator

Operating from a 5 mc internal or external source, the Frequency Generator derives frequencies suitable for exciters or receivers operating in the HF band. A unique system of phase locking free running oscillators to the stable reference frequency provides practically continuous (1 kc) steps, spurious free

(80 db attenuation) injection frequencies. Since the SSB Generator or SSB Receiver with which this unit works covers the 2-30 mc band in 1 kc steps, five controls are required. These controls operate switches which provide signals to a servo positioning system which physically tunes the unit's free running oscillators. This servo is a 60 cycle device which provides a frequency setting accuracy of .03% which is well within the pull-in range of the electronic stabilizer circuits employed.

Single Sideband Generator

The unit is designed to accept two separate 6 kc wide modulation signals and convert them to independent sideband signals around a common suppressed carrier. High grade crystal filters are used to remove unwanted carrier and sidebands after conversion. Attenuation of unwanted spurious products is extremely high; for example, the unwanted sideband is attended 70 db and out-of-band spurious is rejected 80 db. Carrier emmission is adjustable with the minimum level being 50 db below the desired sideband level. Intermodulation products are also very low, being 60 db below the level of one tone on a two tone test.

MW-2 Amplifier

The MW-2 amplifier is designed to provide amplification of radio frequency signals in the 4.0 to 26.5 mc range. When driven with 50 mw of r-f signal, the unit will deliver a minimum of 2.5. kw output with low distortion. Complex signals with a 20 kc bandwidth can be amplified. The equipment employs air cooling. It is designed primarily for fixed station use. All power required can be derived from a three phase 208, 230, or 250 volt power source.

MS Amplifier

The Type MS Linear Power Amplifier is a self-contained air-cooled rf amplifier suitable for fixed station operation in the hf (4.0 - 26.5 mc) band. Its characteristics are particularly suitable for quality single sideband communications applications where up to 30 kw peak envelope power is required. Physically the unit requires considerably less space than existing comparable installation.

Single Sideband Receiver

The SSB receiver is a highly selective and sensitive heterodyne-type receiver. It is designed to accept injection frequencies from the Stable Frequency Generator previously described and convert incoming, 2-30 mc, signals to two independent 6000 cycle audio channels. Since the unit operates in conjunction with the Stable Frequency Generator its accuracy and stability are such that it is possible to use the receiver in applications for which a pilot carrier is not feasible. The preselector is specially designed to provide a high degree of image attenuation as well as to allow the receiver to operate in the presence of high powered signals only a few percent off the desired frequency. Four coupled, synchronously tuned circuits in each band of the preselector, provide 80 db of attenuation to signals 6% from the desired signal. Further reduction of spurious and unwanted close-in signals are attenuated by the filter networks of the dual IF system in which 80 db of attenuation is again presented to undesired signals 6% away from the IF frequency. Detection and channel separation circuits employing ring demodulators and crystal filters are used to provide two quality communications channels with intermodulation suppressed more than

50 db. An AVC circuit is provided which holds the output of each channel constant within 6 db with an 80 db variation in rf input signal. The attack time of the AVC is less than 10 ms to reduce omissions at message beginnings. Decay time or holdover of the AVC system is adjustable in three settings of 0.1, 5, and 10 seconds.

SESSION IV - COMMUNICATIONS TECHNIQUES

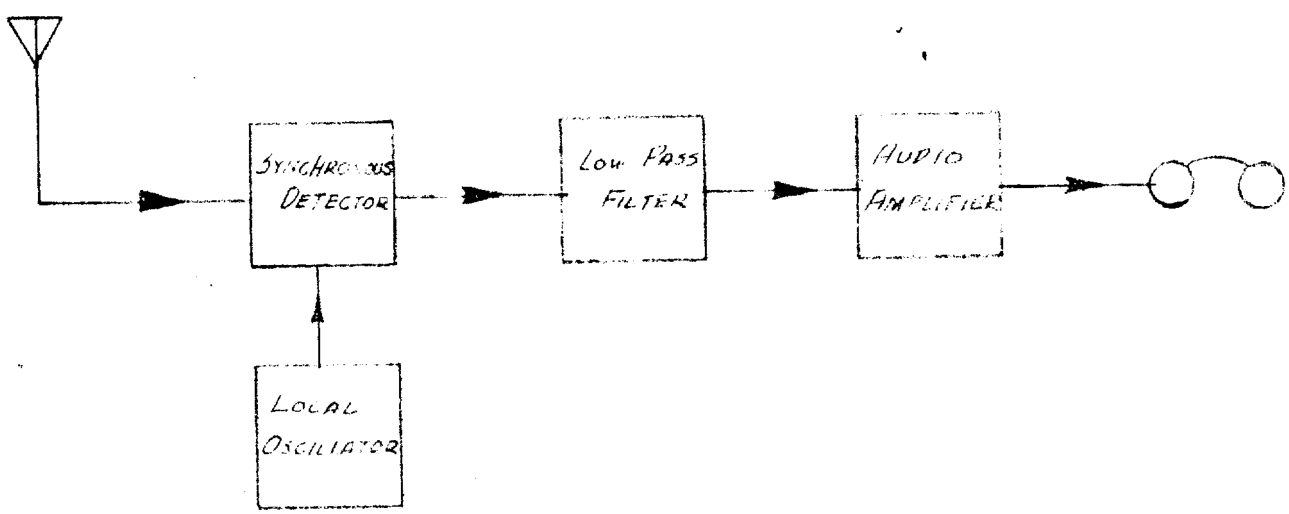
"Synchronous Communications" -
by Dr. J. P. Costas, General Electric Co.

It can be shown that present usage of amplitude modulation does not permit the inherent capabilities of the modulation process to be realized. In order to achieve the ultimate performance of which AM is capable synchronous or coherent detection techniques must be used at the receiver and carrier suppression must be employed at the transmitter. When a performance comparison is made between a synchronous AM system and a single side-band system it is shown that many of the advantages normally attributed to single sideband no longer exist. SSB has no power advantage over the synchronous AM (DSB) system and SSB is shown to be more susceptible to jamming. The DSB system shows a decided advantage over SSB with regard to system complexity, especially at the transmitter.

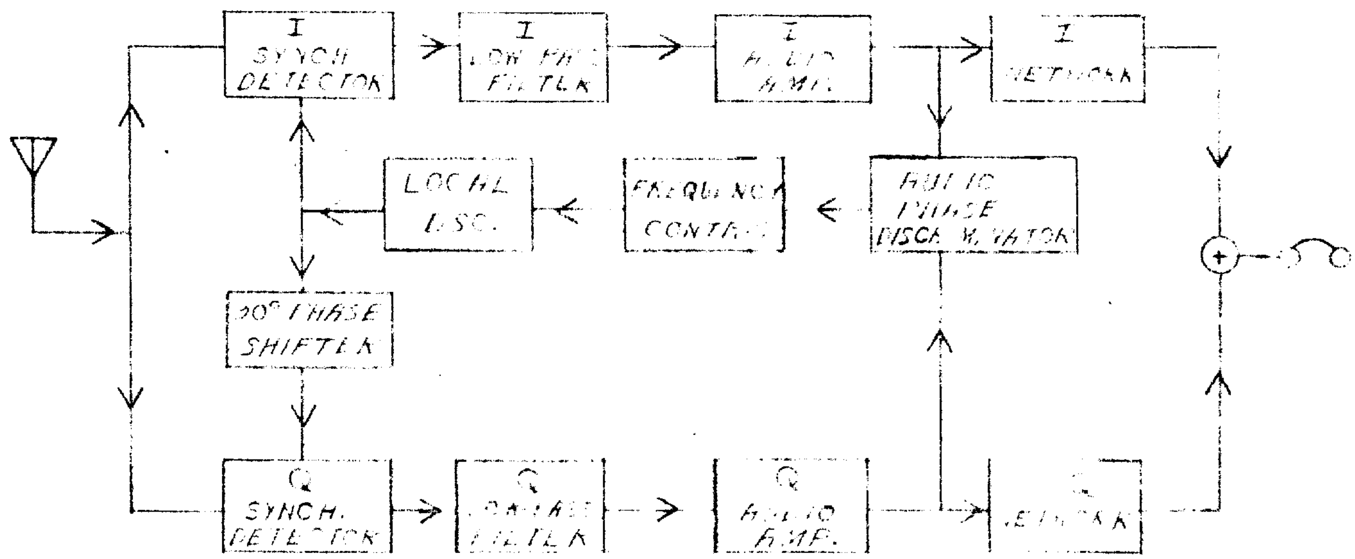
The transmitting and receiving equipment which has been developed under Air Force sponsorship was discussed.

Receiver:

The basic synchronous receiver is shown below:



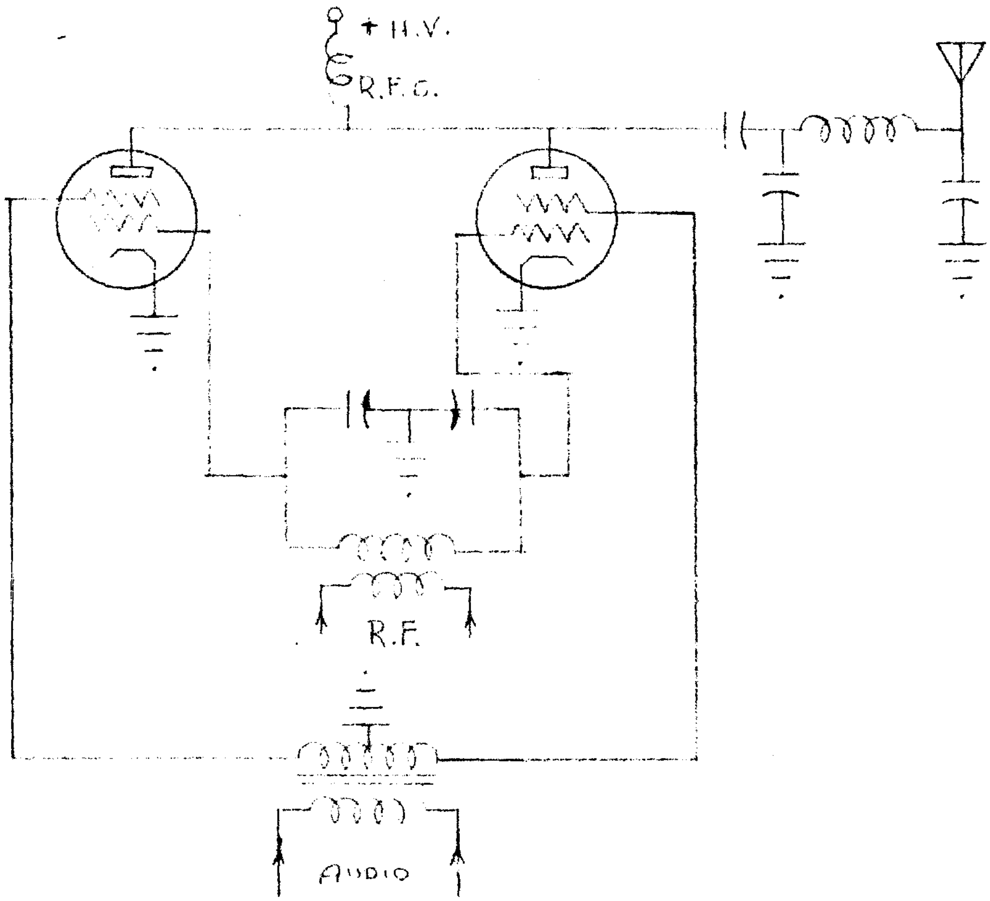
The incoming signal is mixed or multiplied with the coherent local oscillator signal in the detector and the demodulated audio output is thereby directly produced. The audio signal is then filtered and amplified. The local oscillator must be maintained at proper phase so that the audio output contributions of the upper and lower sidebands reinforce one another. If the oscillator phase is 90 degrees away from the optimum value a null in audio output will result which is typical of detectors of this type.In spite of the simplicity of this type of receiver there are several important advantages worthy of note. To begin with, no IF system is employed which eliminates completely the problem of image response. The opportunity to effectively use post-detector filtering allows extreme selectivity to be obtained without difficulty. The carrier component of the AM signal is not in any way involved in the demodulation process and need not be transmitted when using such a receiver. Furthermore, detection may be accomplished at very low level and consequently the bulk of total receiver gain may be at audio frequencies. To obtain a practical synchronous receiving system some additions to the basic receiver are required. A more complete synchronous receiver is shown below:



The first thing to be noted about this diagram is that we have essentially two basic receivers with the same input signal but with local oscillator signals in phase quadrature to each other. To understand the operation of the phase-control circuit consider that the local oscillator signal is of the same phase as the carrier component of the incoming AM signal. Under these conditions the in-phase or I audio amplifier output will contain the demodulated audio signal while the quadrature or Q audio amplifier will have no output due to the quadrature null effect of the Q synchronous detector. If now the local oscillator phase drifts from its proper value by a few degrees the I audio will remain essentially unaffected but there will now appear some audio output from the Q channel. This Q channel audio will have the same polarity as the I channel audio for one direction of local oscillator phase drift and opposite polarity for the opposite direction of local oscillator drift. The Q audio level is proportional to the magnitude of the local oscillator phase angle error for small errors. Thus by simply combining the I and Q audio signals in the audio phase discriminator a D.C. control signal is obtained which automatically corrects for local oscillator phase errors. It should be noted that phase control information is derived entirely from the sideband components of the AM signal and that the carrier, if present, is not used in any way. Thus since both synchronization and demodulation are accomplished in complete independence of carrier, suppressed carrier transmission may be employed.

Transmitter.

The synchronous receiver described above is capable of receiving suppressed carrier AM transmissions. If a carrier is present as in standard AM, this will cause no trouble but the receiver obviously makes no use whatever of the carrier component. The opportunity to employ carrier suppressed AM transmissions can be used to good advantage in transmitter design. There are many ways in which to generate carrier suppressed AM signals and one of the more successful methods is shown below:



A pair of class C beam power amplifiers are screen-modulated by a push-pull audio signal and are driven in push-pull from an R.F. exciter. The screens are returned to ground or to some negative bias value by means of the driver transformer center-tap. Thus, in the absence of modulation, no R.F. output results and during modulation the tubes conduct alternately with audio polarity change. The circuit is extremely simple and a given pair of tubes used in such a transmitter can easily match the average R.F. power output of the same pair of tubes used in SSB-linear amplifier service. The circuit is self-naturalizing and the tune-up procedure is very much the same as in any other class C R.F. power amplifier. The excitation requirements are modest and as an example the order of eight watts of audio are required to produce a sideband power output equivalent to a standard AM carrier output of one kilowatt. Modulation linearity is good and the circuit is amenable to various feedback techniques for obtaining very low distortion which may be required for multiplex transmissions. This transmitter circuit is by no means new. The information is presented here to indicate the equipment simplicity which can be realized by use of synchronous AM communications.

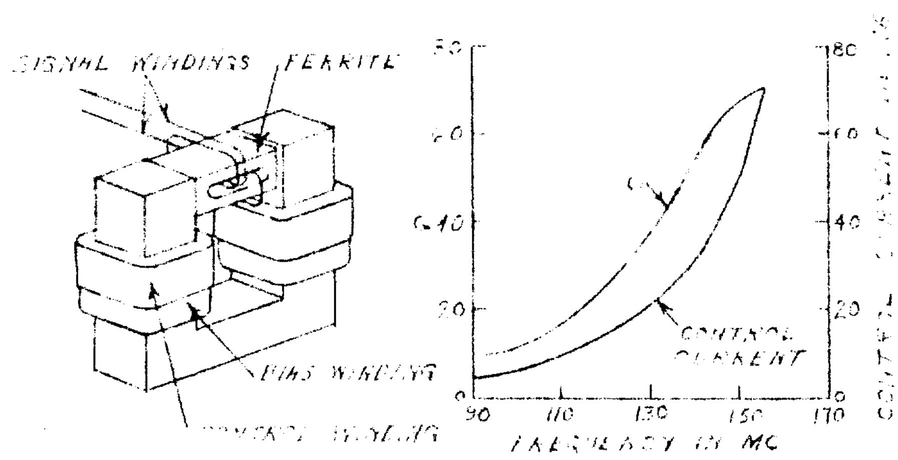
In conclusion, it may be stated that there is an undeniable need for improved communications and to date it appears that single sideband has been almost exclusively considered to supplant conventional AM. It has been the main purpose of this paper to point out that the improved performance needed can be obtained in another way. The synchronous AM system can compete more than favorably with single sideband when all factors are taken into account.

"An Increductor Tuned VHF Panoramic Receiver" -
by Carl G. Sontheimer, CGS Laboratories, Inc.

Designing a VHF receiver with rigid specifications on noise figure and spurious-response level becomes a substantial problem when the receiver is a wide-range panoramic. Solving it hinges upon selecting a sweep component which will give the desired frequency coverage and still lend itself to the design of optimum receiver circuitry.

The use of controllable inductors as tuning elements has made it possible to construct a panoramic receiver to sweep from 100 to 150 mc with a noise figure of about 10 db and with spurious responses (cross-modulation) approximately 70 db below signals. Image responses are about 120 db down.

In superheterodyne receivers, noise figure and spurious-response level are determined by the front end. Considerations of overall gain and selectivity can largely be deferred to the design of the i-f amplifier. Of the various elements available for panoramic tuning, controllable inductors offer advantages in size, weight, stability and freedom from moving parts while meeting the requirement for a 2.25-to-1 reactance swing to cover the 100 to 150 mc range. In addition, they are readily ganged for multiple-tuned circuits and can be made to track accurately in quantity receiver production. Simple circuits can also provide adjustable scan rate, sweep width and sweep center frequency if needed. Controllable inductors selected are CGS XH-147 Increductors units. The construction of these increductors is shown in Figure A below.



"A" "B"

-13-

A rod of high-frequency ferrite material forms the core of the signals winding. The incremental permeability of the core, and hence the inductance of the winding, varied by the amount of magnetic flux created by current in the control winding and carried in the laminated iron yoke. A bias winding establishes the operating point of each inductor. Tracking between units is obtained by adjustment of the d-c supplied to this winding.

The receiver front end was designed to provide the desired degree of image rejection and spurious-response suppression with due regard for the varying Q characteristic of the controllable inductors. Figure (B) above shows measured Q values obtained for a typical XH-147 controllable inductor resonated with fixed capacitor and tuned over the 100 to 150 mc band. The control current required to accomplish this is also plotted. A two-stage i-f amplifier operating at 30 mc is followed by a crystal controlled second local oscillator and a mixer. A second i-f of 3 mc is thus produced. It is amplified in three pentode stages, detected, amplified and applied to the vertical deflection plates of the display tube. The double superherterodyne circuit makes it possible to achieve an effective receiver bandwidth of 30 kc, providing more-than-adequate signal resolution. The receiver is swept at 10 cps. The retrace portion of the sweep waveform resets all the controllable inductors to the same initial magnetic state, thus avoiding mistracking due to hysteresis.

In conclusion, it may be of interest to note an extreme example of "controllable inductorizing." Except for band switches, all the functions of tuning, bandwidth adjustment, beat frequency oscillator operation, type of reception, gain and tone quality can be remotely controlled without mechanical motion in the receiver. Except for frequency stability, which would be of the order of one percent, it will equal or surpass the performance - signal to noise ratio, spurious rejection, and dynamic and tuning ranges - of a conventionally designed receiver up to 30 megacycles. While no one receiver is likely ever to incorporate controllable inductors for all the purposes shown, each of the applications illustrated has its area of utility.

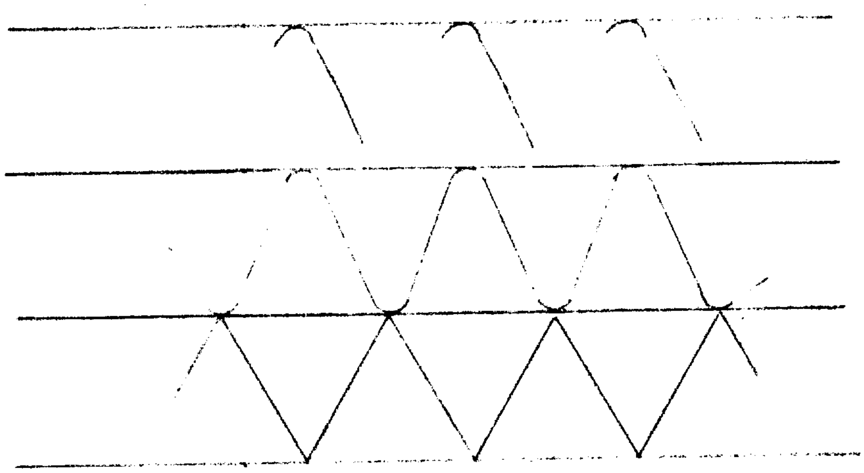
SESSION V - CLASSIFIED SESSION

"Communications Systems of the Future" -
by R. Filipowsky, Westinghouse Electric Corp.

Dr. Filipowsky's paper is an academic review of presently known communication techniques and offers a challenge to the development engineer to tie all communications means into a single world-wide system in the next 1 to 5 decades. Broad communications methods extending from voice to visual were described in terms of a single digital system. Third dimensional communications were visualized and the need for redundancy reduction was stressed. The development engineer's tools were described as waveform, frequency and amplitude in both asynchronous and synchronous time division. A copy of Dr. Filipowsky's paper will be available in the near future.

"Anti-Jamming and Security Performance of Passive Ternary Data Transmission of Binary Signals"
by Mr. E. Sherer, Westinghouse Electric Corp.

This paper describes a theoretical study of improved communication reliability in the presence of jamming as one step directed towards meeting the challenge of Mr. Filipowsky's paper, above (Filipowsky assisted in the presentation). Passive ternary binary data consisting of bits A, B plus a void with a repetition rate of 2,500 cps were said to reject jamming with pulse shape examination, comparison and reshaping. The system was said to be satisfactory for AM, FM, and constant level speech. Constant level speech was described as raising the audio frequency one octave and clipping to produce a frequency division sawtooth.of constant amplitude.



Intermodulation distortion is high. The paper concluded with the statement that SSB reception offers a 12 db greater immunity to jamming over other systems.

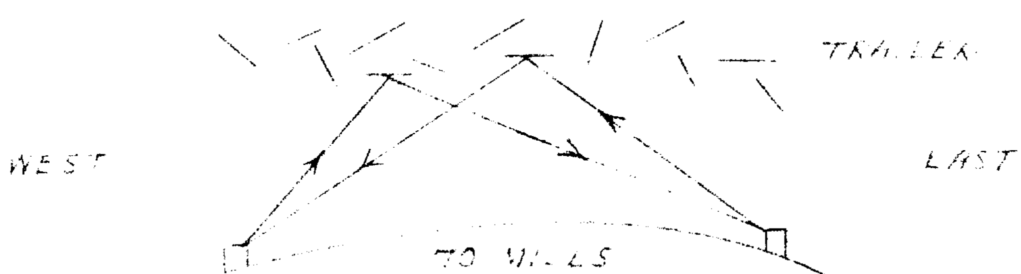
"A Comparison of Voice Modulation System in the Presence of Jamming" -
by Mr. S. Zebrowitz, Philco Corp.

The scheduled speaker was absent and Mr. Zebrowitz filled in with a recorded play-back of various levels of white noise combined with SSB reception of voice modulated signals.

"Meteoric Scatter Studies" -
by Mr. A. M. Petersen, Stanford University

Ionization trails resulting from meteor bursts are useful for refracting radio waves back to the earth to provide secure communications over a distance of from 25 to 1500 miles. The ionization trails are 100 kilometers above the earth's surface. Intercept stations located more than a few miles away from the target station will not share the path and the system is free from jamming.

A study has been completed that indicates that the East to West path is different than the West to East path as sketched below:



Additional studies will be made to determine if any difference exists between the North-South and South-North paths.

Dr. Petersen pointed out the need for speeded-up teletype and slow playback and felt that such a system would require a large capacity storage matrix with extremely high speed transmission. (No multipath problems are inherent in this system.)

"Frequency Division Data Link"
by Richard Fry, General Electric Co.

This paper describes a Universal Beacon for flight control (data Link) during mid-course guidance. The system which operates in the UHF has 1750 channels 100 kc/s apart, each with a bandwidth of 20 kc/s.

The following papers were not presented:

Long Range Communications Studies	B. Miller, Ramo-Wooldridge Corp.
Factors Behind Data Link Studies	H. Held, Lockheed Aircraft, Inc.
Time Division Data Link	C. K. Law, RCA

Although Dr. Costas created quite a stir with his dynamic "throw-out the super-hetrodyne" address on synchronous communications, it was learned later at Electronic Park that Costas asked for a release from such R&D studies, and is now in "production". Dr. Petersen's discussion on meteor bursts is contrary to our understanding that reciprocity is a requirement for the successful functioning of Project Janet. An attempt was made to find Petersen during the luncheon break to discuss this, without success.

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Manufacturer's literature from the exhibits is available.